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THOUGHTS
CONCERNING
THE USES
OF
CLAY MARL,
AS
MANURE.

BY THE

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Vicar of MANFIELD, *in Yorkshire*, & LONG-HORSLEY,
in Northumberland.

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TO

MR J. WILSON, of DARLINGTON;

MR CHARGE, of NEWTON;

MR LAX, of BARTON;

MR C. CHARGE, of MIDDLETON-TYAS;

AND

MR DAWSON, of ALDBROUGH,

The following Thoughts are dedicated, concerning the Uſes of CLAY-MARL, *as Manure, by their*

Obedient and Humble Servant,

JAS. ATHOL COCHRANE.

GENTLEMEN,

WHEN I had the pleaſure of your company to dinner, at *Manſield*, upon the 25th of June, it was agreed upon, that I ſhould draw up my Sentiments upon the ſubject of the Trials of Clay-Marl, propoſed to be carried on under your Inſpection, upon the Glebe Land, belonging to the Vicarage of *Manſield*, in Yorkſhire.

In conſequence of Mr Tooke, who wrote the general View of the Agriculture of the North-Riding of Yorkſhire, having made the aſſertion in Page 53 of ſuch work, "That it "does not appear that Marl, now is, or ever "has been made uſe of as a Manure, or is to "be found, in any part of this Riding" I undertook, and have finiſhed, the following work, viz. Obſervations concerning the Diſcovery of various ſorts of Marl, in the Counties of *York*, *Durham* and *Northumberland*: with occaſional Remarks as to the ſituation of theſe Counties: in reſpect of natural Manures, or thoſe artificial Manures that may be manufactured according to two ſpecified Methods, of decompounding Coal, Wood, Peat, or Turf, by Fire and Diſtillation: as alſo concerning the Eſtabliſhment of Manufactures of Agricultural Salts, upon the Rivers Humber, Merſey, Severn, Forth, and Clyde, and in the Ports of Shields, Sunderland, Whitehaven, and Workington; by a Mode of uniting in one Maſs, or forming, in different Combinations, the principal Salts that are uſeful in Vegetation, or Promoters of Putrefaction, without any detriment to the Duties now raiſed on common Salt. Previous to the publication of which Work, I thought it might be of ſervice to the Neighbourhood, were a ſet of Experiments of Clay Marl, with or without Manure, begun upon my Glebe Land, under the Guidance and Direction of you, Gentlemen, as real practical Farmers. It is my wiſh, therefore, that you ſhould keep your Opinions upon ſuch Trials, perfectly ſecret among yourſelves, until Experience has enabled you, to make up your Judgments of the Utility or Inutility of ſuch Clay Marl.

As the Counties of *Norfolk* and *Lancaſter*, have experienced great Improvements in their Agriculture, from uſing various ſorts of Marl, ſo it is my ſincere wiſh, that the North-Riding of Yorkſhire, and South Diſtrict of the County of Durham, may be taught from Experience, the value of thoſe Strata of Clay-Marl, of which there are inexhauſtible Quantities in the Counties of York, Durham and Northumberland.

The Glebe Land of Manfield conſiſts of 104 Acres, the lower part of it borders upon the River Tees, and has been in conſtant Tillage theſe hundred Years: The ſoil is a heavy loamy Gravel: Convenient for this part of the Farm, there is a Stratum of dun coloured Marl, upon a Hill, from ten to fifteen feet in thickneſs, ſo that the Carts have only to lead it down to lay it in the Fold Yard.

The upper part of the Glebe conſiſts of a loamy Clay. It has not been long in Tillage. Here upon the Centre of theſe Lands, there is a fine poſt of Chocolate coloured Clay-Marl, ſtreaked with white, ſix feet thick with a blue Marl under it all Level free.

The Hill that leads down from the Glebe Land to Cleaſby, is, in many places, one continued Stratum of Clay-Marl, both red and blue. It runs on both ſides of the River Tees to Croft, and from Croft to Yarm, and ſo from it to Stockton, Portrack, Cowpen, and Mandell upon the Yorkſhire ſide, belonging to Lord Harewood, there are few more extenſive fields of Clay-Marl in England than the above were the different Seams of it properly aſcertained and analyzed. This Stratum of Clay-Marl may be ſeen upon Mr Witham's property, where the River Tees has laid it bare, twenty or thirty feet in thickneſs, oppoſite to Lord Ayleſbury's and Mr Howard's Eſtates: At Cleaſby it paſſes through the Duke of Devonſhire's Eſtate. This Marl is of two kinds, either a dun colour or chocolate ſtreaked with white. A blue Marl may be ſeen at Stappleton Ferry, under the Gravel, and a very fine poſt of chocolate coloured Marl, runs along Blackwell Hill, where the Road is cut through it, it paſſes through a Farm belonging to Mr Arden, of Pepper-Hall. An excellent Stratum of dun coloured Marl may be met with upon the Road leading from Hurworth to Croft Bridge, not above 150 Yards from it. A ſimilar Marl appears at the Brick Kiln Pits at Hurworth, and Darlington upon the Stockton Road. By trial of the Marine Acid, both the Marls of Manfield Glebe were compared, in your preſence, Gentlemen, with two Samples of the beſt Lancaſhire Clay-Marl, and found fully equal to them. Some of the Clay-Marls upon the Tees, are 14 per Cent richer than the Lancaſhire Marl, in reſpect of Chalk, or calcareous Matter.

Concerning Clay-Marl, Dr Home gives the following Account, in his Principles of Agriculture and Vegetation, “ Marl is a foſſil Body, which feels unctuous and fat betwixt the fingers, and reſembles Clay in a great meaſure, inſomuch that Marl, though a very different body, is often confounded with it. It is divided into many different kinds, which may all be included under theſe two, Clay, and Slate or Stone Marl, for what is commonly called Shell Marl, is an animal Subſtance, and therefore to be claſſed amongſt them. The different colours of Marl make no difference as to their Properties. It is a diſtinguiſhing and Characteriſtical property of Clay Marl, that when it is put into Water, it falls down into a Powder. The Clay Marl diſſolves

" much quicker than the Stone Marl. This " quality muſt be owing to the weak adheſion of its Particles; ſo that the ſmall Force " with which water enters its Pores, is capable of ſeparating the Particles of the Marl. " By this Property it is ſufficiently diſtinguiſhed from Clay, which does not ſo ſpeedily admit the entrance of Water. As Clay " Marl is ſo much opened by Water, as to " loſe its natural Coheſion entirely, we ſee " how much it will favour the eſcape of Water from ſuch Grounds, as have been manured with it. Clay Grounds, after they " have been marled, become much drier. It " is owing to the Water getting off ſo quickly, that marled Lands are leſs affected by " Froſt, than the ſame Soils which have not " got any Marl."

" Marl efferveſces with all the different " Acids, and turns with them, into a neutral " Salt. It has already been obſerved, how " ſoon Clay Marl, when dry, loſes all Adheſion in Water, and falls down into a Powder. The ſame power it communicates to " other Earth, even the moſt adheſive. The " following Experiment is a proof of this. " Take equal parts of Marl and Clay, mix " them well together and dry them; when " this compounded Subſtance is put into Water, it falls by degrees to the bottom of the " Glaſs in the Shape of a Powder, while a " Ball of pure Clay remains quite indiſſoluble " in Water. This ſhews the ſtrong attenuating power which Marl has, and which no “other Body can come up to. It is obſerved, that all Clay Grounds after they are marled, dry fourteen days ſooner than what they did before. This muſt be owing to the Soil being more looſe, by which means the Water pervades it more eaſily.” Dr Home mentions that this Opinion contradicts the common one, that Clay Marl is not fit for Clay Grounds. From whence this Opinion has taken its riſe, he knows not, if it is not, that Bodies of ſuch a ſimilar appearance cannot be allowed to benefit one another: But the experience of many Counties where Clay Marl is uſed, and where the Soil is generally a deep Clay, contradicts this vulgar Opinion. Dung and Marl appear to be the beſt Manures for Clay. The former cauſes a ſtrong fermentation: and the Marl looſes all Coheſion when water is added.”

Extract from Mr Holt's general View of the Agriculture of the County of Lancaſter, “Clay Marl is the Foundation of all Improvements in the County of Lancaſter; and here the Huſbandmen of Lancaſhire and Cheſhire may afford an uſeful Leſſon to the reſt of the Kingdom; ſo well are they convinced of the neceſſity of attending to this primary Object that neither Labour nor Expence deter them from the moſt vigorous Application of it There are ſeveral varieties of this Foſſil Manure valuable in proportion to its intrinſic qualities or the nature of the Land to which it is applied.

Mr Holt gives the following Analyſis of 4 Samples of Lancaſhire Clay Marl: The Product were from 100 Grains of each as follow:

	No. 1.	No. 2.	No. 3.	No. 4.
Flinty Sand	$40\frac{1}{2}$	$40\frac{1}{2}$	34	$32\frac{7}{10}$
Clay & Sand	$39\frac{1}{2}$	39	44	$47\frac{3}{10}$
Calcareous Earth or Chalk	$19\frac{1}{2}$	$20\frac{1}{2}$	22	20
Loſt	$\frac{1}{2}$			

The following is an Analyſis of Clay Marls, ſelected from various Samples of the Counties of York, Durham, and Northumberland.

Portrack Clay Marl, near to Stockton, County of Durham.

Grains } 36 of Calcareous Earth.
100 } 64 of fine Clay.

Mr Simpſon's Clay Marl, at Newham, Yorkſhire, near Stockton.

Grains } 20 of Calcareous Earth.
100 } 80 of coarſe Clay and Grit.

Clay Marl at Cowpen, in the County of Durham, near Stockton.

Grains } 34 of Calcareous Earth.
100 } 66 of fine Clay.

Mr Chaloner's Clay Marl, at Holbeck-Mill, near Guiſbrough, Yorkſhire.

Grains } 22 of Calcareous Earth.
100 } 78 of fine Clay and Sand.

Clay Marl, near Greatham, County of Durham.

Grains 100 } 17 of Calcareous Earth.
78 of fine Clay and Sand.

Clay Marl over the Limeſtone, at Hartlepool.

Grains 100 } 24 of Calcareous Earth.
76 of fine Clay and Sand.

Brown Clay Marl, upon the Glebe, at Manfield, Yorkſhire.

Grains 100 } 17 of Calcareous Earth.
83 of fine Clay.

Grey Clay Marl.

Grains 100 } 20 of Calcareous Earth.
40 of fine Clay.
40 of Grit and Sand.

Dun Clay Marl, upon the Glebe, at Manfield.

Grains 100 } 22 of Calcareous Earth.
78 of fine Clay and Sand.

Chocolate Coloured Marl, ſtreaked with white, upon the Glebe, at Manfield.

Grains 100 } 23 of Calcareous Earth.
77 of fine Clay.

The Obſervations, Gentlemen, contained in the Sequel of this paper, concerning increaſing the means of making Manure, by a commixture of Clay Marl with Dung, Sods, Peat, Salts, and decompounded Foſſil Coal, Wood, or Peat, are particularly addreſſed to the Gentlemen and Farmers of the Pariſhes of Long-Horſley, in Northumberland, and Manfield, in Yorkſhire, of which I am the Vicar. With a view of ſetting agoing Trials of Clay Marl, in Long-Horſley Pariſh, ſimilar to thoſe now begun at Manfield. I ſhall beg leave to inſert here an Analyſis of ſome Clay Marls, in that Pariſh, and its Neigbourhood, in Northumberland.

Analyſis of Clay Marls, in Northumberland.

Wingate Clay Marl, in the Pariſh of Long-Horſley, belonging to Mr Trevylian, and Mr Silvertop.

Grains 100	28½ of Calcareous Matter or Chalk 71½ fine Clay and decayed vegetable matter.

Clay Marl upon the Glebe Land, belonging to the Vicarage of Long-Horſley.

Grains 100	15 of Calcareous Matter. 85 fine Clay and Sand.

Mitford Clay Marl, near Morpeth.

Grains 100	13 of Calcareous Matter. 87 fine Clay and Sand.

Calcareous Loam or Sand that lies between the Strata of Clay Marl, above Weldon Bridge.

Grains 100 } 23 of Calcareous Matter.
77 Sand and fine Clay.

Mr Blakey's Clay Marl, at Snow Hall, near Elldon, Northumberland.

Grains 100 } 28 of Calcareous Matter.
72 fine Clay and decayed Vegetable Matter.

In the Survey, Gentlemen, that I intend ſoon to publiſh, at York, concerning the Diſcovery of various ſorts of Marl in Yorkſhire, Durham, and Northumberland, I have given an Analyſis of ſome rich Peat Shell Marls, found in theſe Counties.

Account of Clay Marls, diſcovered in Long-Horſley Pariſh.

A Clay Marl of a Chocolate colour, and from ten to fifteen feet in thickneſs, may be ſeen upon Mr Riddle's Eſtate, below Horſley Mill. It croſſes the Turnpike Road at Horſley Mill, holding its Courſe to the Weſt and Eaſt, through the Earl of Carliſle's Property, Mr Riddle's, the Glebe Land, and the Grounds belonging to the Freeholders, South-Weſt of Long-Horſley Village. The richeſt Land in that Pariſh lies to the Eaſt of the Village, and there is every reaſon to believe it is owing to a bottom of Clay Marl. It is neceſſary to point out here, Gentlemen, the Propriety of opening Marl Pits for the Convenience of the Tenants of the above Eſtates. The Marl Pit upon the Earl of Carliſle's Eſtate, ſhould be opened upon Thomas Kirſop's Farm, adjoining to the Vicarage of Long-Horſley, and that upon Mr Riddle's at Horſley Mill, either Eaſt or Weſt of Horſley Mill, as the Ground affords a good level for ſuch Purpoſe. The Clay Marl upon the South Glebe Land belonging to Long-Horſley, has lately been aſcertained by boring, to be 24 feet in thickneſs, with a good Level. It is found in the Earl of Carliſle's Farm at Todburn, Mr Trevylian's Eſtate at Wingate, Mr Liſle's Farm, rented by William Moor, and in Mr Riddle's Farm to the North-Eaſt of Todburn. The fineſt Stratum of Clay Marl, perhaps in Northumberland, may be ſeen near Weldon-Bridge, upon two Farms rented by Thomas and George Hare, belonging to Mr Riddle, of Felton: Alſo upon a Farm rented by John Thompſon, and belonging to Mr Liſle, of Acton. The River Coquet has laid open this Seam of Marl nearly twenty feet in thickeeſs, and between its Strata there are Seams of rich Calcareous Loam. This Clay Marl may be diſcovered ten yards above the Inn, at Weldon-Bridge, in ſuch a ſituation where it might be cut through to level the Road to Newcaſtle and ſhew the Farmers in the adjacent Country the nature of ſuch Marl. It holds its Courſe to the Eaſt, towards Felton. It paſſes alſo to the South, under Weldon-Bridge, and may be traced in the Ditches, a conſiderable way up that ſteep Bank that leads to Long-Horſley. This Clay Marl runs up the Hill from Weldon-Bridge to Low Framlington, and bends its Courſe to the North-Eaſt to Elyhoff and Swarland. In the Neighbourhood of Weldon-Bridge, there is more Clay Marl than is adequate to ſupply all the Country round it, upon the Plan of making Manure recommended in this Paper. The Soil of Manfield and Long-Horſley Pariſhes in many parts will be greatly benefited, Gentlemen, by a liberal Application of Clay Marl, where they conſiſt of a cold white Clay mixed with Sand, or an Irony Clay with much Sand.

" Mr Holt, in his Agricultural Report obſerves that innumerable inſtances are to be found in Lancaſhire, where barren Heaths and wretched Sands of all Deſcriptions, have been rendered in the higheſt degree productive by this admirable Foſſil Clay Marl : Indeed there is reaſon to believe, that far the greateſt part of the Diſtricts where Marl is to be found, in Lancaſhire, has been reclaimed by it. It is of the utmoſt Importance to attend to the Application of Marl, therefore, the Conſequences of making ſuch practice more generally known require a full and detailed Narration."

" The Summer is the beſt Seaſon for laying Clay Marl upon the Land, ſometimes immediately after a Crop of Hay has been taken. The general Experience of this Country, has proved to Demonſtration the Propriety of its univerſal practice, viz. to lay it upon Graſs which is intended to be broke up the enſuing Spring. Its Effects upon Graſs are ſoon viſible, from the rich Verdure which it produces. The older the Graſs Land is the better, the Sward and Graſs united together with the Marl, cauſe a Fermentation and Putrefaction, which ſeem neceſſary to produce a proper Effect. Sometimes the Marl has been ſpread upon the green Sward, and left unploughed many Years, in this Caſe the Graſs ſometimes receives conſiderable Detriment, as the Marl ſinks downwards in a Body, without incorporating with the Soil, though when Marl has been ſeveral Years in this State, the ſubſequent Crops have been enormous."

"The quantity of Marl laid upon a Statute Acre, in Lancaſhire, is from two, to three, or three and a half Cubic Rods of 64 Yards of Marl, two Cubical Yards of Marl make about three Cart Loads of 15 Cwt. equal to two Tons five hundred Weight. This at the rate of two Cubic Rods of 64 Yards to a Statute Acre, gives 144 Tons of Marl, at the rate of three, 216 Tons, and at the rate of three and a half, 252 Tons to each Statute Acre, the Expence of which is according to the diſtance carried. It is reckoned a much better practice to have the Marlings repeated with a gentle covering, than a ſtrong thick Coat, of Marl."

"The general Rule is, to begin Marling about May or June, when Spring Seedings are over, continuing as Opportunity ſerves throughout the Summer Months, by this

Mode the Marl partakes of one Summer's Sun, and one Winter's Froſt; after being expoſed to the Effects of the Weather, in large lumps it begins to fall or melt; the Particles appear unctuous and ſoapy, and the quality of the ſubſtance ſeems quite changed from its original State. Then, in the enſuing Spring, it ſhould be divided, as the parts now ſeparate with eaſe, and equally diſtributed upon every part of the Surface, this is with facility effected with Harrows, after which, it is uſually ploughed under, but if permitted to remain a Year or two longer, the Lands would be more improved in the Iſſue, by the length of time given, previous to the Marl being ploughed in. But the Marl does not produce its full Effects upon the Soil, till intermixed and incorporated by a repetition of Ploughings, and an Intermixture of Dung, or other Manure, for Marl is not effectual without ſuch Addition. This Subject cannot be too often brought under Review, as it appears ſo little noticed, in the various Agriculture Reports."

In this Reſpect, I preſume Gentlemen, that a great Advantage will be obtained in having always upon the Glebe Land, a Quantity of Marl thrown out of the Pits ſufficient to ſerve for two or three Years, according to this Plan, it ſhould act immediately as a Manure, in commixture with other Manure.

The Courſe of Crops recommended by Mr Holt after Marling, is as follows, viz. "To take one Crop of Oats the Spring ſubſequent to the Marling,—Plough the Stubble immediately, in Order to expoſe the Marl to the Influence of the Froſt; fallow with Manure for Turnips,—a Crop that is under this management, is never known to fail,—then Barley, Clover, Wheat, Turnips fed off with Sheep, and Barley again, with well dreſſed Hay-Seeds, white Clover and Trefoil, for a perennial Lay, or at leaſt for ſome Years; Land thus huſbanded, produces in a moſt exuberant Degree, and at the ſame time, is rendered perfectly clean from all Weeds, without being the leaſt haraſſed.

“ Mr Holt concludes his Account of the Lancaſhire Clay Marl in the following Terms: Marl is an excellent improver of the Soil, under ſo many different Circumſtances, that it cannot be recommended too often, nor praiſed beyond its Merits. It adds to the Staple of the Soil, and improves its quality, and renders Manure, of whatever kind, more effectual, with leſs in quantity, it will admit a Repetition of the Proceſs, with equal Advantage, again and again. In ſhort, ſo far as Experience proves in Lancaſhire, it ſeems the grand Baſis whereon every Agricultural Improvement ſhould be eſtabliſhed After the preceding accounts given of the uſes of Clay Marl in Lancaſhire with the Proofs, Gentlemen, exhibited that the North-Riding of Yorkſhire, and the Counties of Durham and Northumberland, have Marls of equal Value, it is only neceſſary to obſerve, that in a Bed of Clay Marl from 4 to 20 Feet in thickneſs, various Seams will be met with as to quality, therefore, there is reaſon to hope, the more the ſubject is inquired into by our Northern Men of Property, the more uſeful Diſcoveries they will make. I ſhall conclude this Paper, Gentlemen, with ſome uſeful Quotations and Remarks, from Chymical Writers of Credit, upon the Principles of promoting Putrefaction, and making Compoſt Dung-Hills, to eſtabliſh the merit of Clay Marl in theſe Reſpects.

Every perſon of common obſervation muſt ſee, Gentlemen, how little Attention is paid by many Farmers, to the Preſervation of the Urine of their Cattle and Horſes, and even Dung itſelf. It ſeems, as if many Farm-Yards were contrived on purpoſe, to let the Urine eſcape, as a Nuiſance, inſtead of being an Advantage. The following Quotations, from one or two Chymical Writers, will point out the Propriety, of mixing Vegetable and Animal matter with Clay Marl.

Sir John Pringle made the following Experiment, to diſcover the Effects of mixing Vegetable with Animal matter, viz. two "Drams of raw Beef, as much Bread, and an Ounce of Water, being beat to the conſiſtence of Pap, and expoſed to ninety degrees of Heat, according to Farenheit's Thermometer, began to ferment in a few hours, and continued in Fermentation during two Days. When it began to ferment and ſwell, the Putrefaction had begun; and in a few hours afterwards the ſmell was offenſive. Next day the Putrid ſmell ceaſed, and an Acid taſte and ſmell ſucceeded. From the above Experiment, Sir John Pringle found that Animal Subſtances excite the Fermentation of Vegetable Subſtances, and that the latter Subſtances correct the putreſcency of the former. By adding an Oily ſubſtance to the common mixture of Fleſh, Bread and Water, a ſtronger Fermentation was produced, which could not be moderated till ſome fixed Alkaline Salt was added, which Salt was found, to ſtop ſuddenly very high Fermentations.

Lime Water was found to make ſome ſmall Reſiſtance to Putrefaction, " Dr Macbride's Experiments confirm thoſe of Sir John Pringle, eſpecially thoſe which ſhew that the Fermentation of vegetable Subſtances is increaſed by a mixture of Animal or Putreſcent Matter, that the Putreſcency of the latter is corrected by the fermentative quality of the former, and that the Putrefaction and Fermentation of mixtures of Animal and Vegetable Subſtances were accelerated by Additions of Clay, Calcareous Matter, Chalk and Magneſia. He alſo found, that although unburnt Calcareous Earths or Limeſtones were promoters of Putrefaction, quick Lime and Limewater prevented Putrefaction.

Extract from a Work written by Meſſrs Fourcroy and Vauquelin, concerning the natural and Chymical Hiſtory of Human Urine, with its Analyſis and ſpontaneous Alteration.

According to the above Chymiſts, Human Urine contains ten principal or conſtant Ingredients, viz. Sea Salt, Sal Ammoniac, Acid Phoſphat of Lime, Phoſphat of Magneſia, Phoſphat of mineral Alkali, Phoſphat of Volatile Alkali, Uric Acid, Benzoic Acid, Jelly, and the Specific matter of Urine, denominated Ure.

To this matter Urine owes the property of becoming by ſpontaneous Fermentation a Fluid ſo different from what it is when firſt voided, ſo as to contain nine new Ingredients. Many of the above Salts are active Promoters of Putrefaction.

Newman, in his Chymiſtry, obſerves, that the Urine of Brutes contain nearly the ſame Ingredients as human Urine.

It may be fairly aſſerted, that the Urine of Cattle will make four times more vegetable matter into Manure, than is contained in their own Dung.

The following is the Method of making Manure, with Clay Marl, at the Vicarage of Manfield, and at the Farm-Houſe, belonging to the Glebe Land.

1ſt. The Clay Marl was commonly laid pounded, in the Channel of the Stable, or Cow-Houſe, where the Urine from the Cow, or Horſe, along with the Dung, was mixed with it every other Morning. Whenever the Marl ſeemed to be completely ſoaked and ſat-

tured

ured with the Urine and vegetable matter of the Dung, which may be eaſily known by the Unctuous Appearance of the Commixture, then an equal quantity of Sods, or pounded Peat, ſhould be added to it. When this has lain ſix Months, and has been turned once or twice, it will admit of an equal quantity or twice that of Clay Marl to be added to it. It may be better that ſuch Sods, or Peat, be in Heaps a Month or two, before the Commixture, and that ſuch mixture be turned over once or twice, during ſix Months, before it is uſed as Manure.

This mode of making Manure, corrects the preſent improper Plan in many Farm Yards, of allowing the Urine to eſcape, and the unctuous part of the Dung being conſumed by Flies and Exhalation. By a due Commixture of Clay Marl with Urine, and Dung, Sods, or Peat, all the Advantages enumerated in Sir John Pringle' and Dr Macbride's Experiments, to aſcertain the Principles of making Manure are united, viz. 1ſt. That the Fermentation of Vegetable Subſtances is increaſed by a mixture of Animal, or Prutreſcent, Matter: 2d. That Clay Marl, which conſiſts of Clay and unburnt Calcareous Matter or Chalk, is a powerful Promoter of Puttrefaction, and Fermentation. 3d. That according to Dr Home, Clay Marl ſtrongly attracts Oils, and conſequently by Abſorption prevents the Evaporation of the Oleaginous Matter in large Compoſts and Commixtures of Manures. This is a quality, ſays Dr Home, which the Chymiſts know belongs to all Abſorbent Earths, viz. Clay, Chalk, or Magneſia, hence Clay Marl will attract and fix the Oils, which it meets with in the Ground, or thoſe which fall with Snow or Rain, and even thoſe which floating in the Air, touch its ſurface.

In the Vicarage Garden, at Manfield, this Year, 1800, ſome Experiments are making with the above Compoſt in regard to Potatoes, and there is great Reaſon to expect that Clay Marl will make the Culture of this uſeful Root more common among Farmers, by ſtrengthening and lightening the Staple of the Soil.

The Farmer upon the Glebe Land, at Manfield, has this Year, 1800, tried eight Acres of Turnips with a Compoſt of equal quantities of Dung and Clay Marl, commixed at the rate of thirty Loads and forty-two Loads per Acre. Four Acres upon a heavy loamy Gravel, and four upon a loamy Clay. This Compoſt had been formed, Gentlemen, only one Month before it was laid upon the Ground. But in future, the Farmer is to bottom his Fold Yard with two feet of Clay Marl, and commix it in Layers as the Dung comes from the Cattle, or to commix it in the Field with the Marl, in ſituations convenient for the Farm. Such Compoſts are to be formed for nine or twelve Months, before they are uſed as Manure, and turned over three or four times.

"To Mr Haſſenfraz, Gentlemen, (ſays that eminent Chymiſt, Kirwan) we owe the Diſcovery, that Coal, contained in Carbonic Acid or fixed Air, is an eſſential Ingredient in the Food of all Vegetables, though hitherto little attended to, it appears to be one of the primeval Principles, as ancient as the preſent Conſtitution of our Globe, for it is found in fixed Air, of which it conſtitutes ¼ part, and fixed Air exiſts in Limeſtones, and other Subſtances, which date from the firſt Origin of Things."

"Coal not only forms the Reſiduum of all vegetable Subſtances, that have undergone a ſlow and ſmothered Combuſtion, that is to which the free acceſs of Air has been prevented, but alſo of all putrid Vegetable and Animal Bodies. Hence it is found in Animal and Vegetable Manures, that have undergone Putrefaction, and is the true Baſis of their ameliorating Powers, or in other Words, reſtores to Land what has been taken from it by former Crops. If the Water that paſſes through a putrefying Dung-Hill be examined, it will be found of a brown Colour, and if ſubjected to Evaporation, the principal Part of the Reſiduum will be found to conſiſt of Coal. All Soils ſteeped in Water communicate the ſame Colour to it, in proportion to their fertility, and their Waters being evaporated, leaves alſo Coal, as Mr Haſſenfraz and Fouraroy have ſtated and atteſted." Fixed Air is the Air which Limeſtone loſes in being burnt, or the Air which eſcapes from Beer in Fermentation.

Dr Home, Gentlemen, in his Principles

of Agriculture and Vegetation, obſerves, "that the Effects of different Manures on the Ground, ſhould be viſible, in proportion to their Strength of holding or attracting Acids. This happens really as to Alkaline Salts. Aſhes have the ſpeedieſt Effects of any Manure, becauſe the Alkaline Salts which they contain, attract Acids ſtronger than any Body. Soot and Dung come next, which are Volatile Alkalines, whoſe attraction comes next to the firſt, then the Claſs of abſorbent Earths; the ſame Obſervation is made of Marls, according to their Rank as attracters of Acids, ſo they operate on Ground, firſt ſhell, next Clay and laſt of all Stone Marl: which will ſometimes continue in the Gound four or five Years before it ſhew any Effects. The ſame turn all theſe Manures keep in loſing their Effects; for the ſooneſt converted into Salt muſt be the ſooneſt exhauſted.

It is obſerved, Gentlemen, "by the Earl of Dundonald, in a Treatiſe he lately publiſhed, to ſhew the intimate Connection, that ſubſiſts between Agriculture and Chymiſtry, that by the Adoption of a new line of Inveſtigation, exemplified in his Treatiſe, Light has not only been thrown on the Action and Effects of the Manures at preſent employed, but the uſes of other Subſtances, and Methods of combining and preparing them, have been diſcovered; from which there are juſt Grounds to believe a valuable Addition will accrue to the preſent Stock of Agricultural Knowledge.

It will appear that the Saline, and other Subſtances capable of being applied to promote Vegetation, are very numerous; by far the greater part of them have eſcaped the notice of thoſe who have made Agriculture their Study, nor have proper attempts ever been made to explain on Chymical Principles the Operation of the Manures and Subſtances now in uſe. Were ſuch Reſearches proſecuted to Effect, they will lead to the Diſcovery and Application of other Subſtances capable of being employed, with equal, or perhaps ſuperior, Advantages.

Theſe Obſervations, Gentlemen, you have ſeen exemplified, in this Paper, as to Clay Marl and its Combinations, however, I hope you will have ſoon many uſeful Hints, concerning the Manufacture of Agricultural Salts, communicated to you, when the Work I am engaged in is publiſhed at York, along with the following Preface, addreſſed to His Grace the Duke of Northumberland, the Right Hon. the Earl of Lonſdale, and Right Reverend the Biſhops of Landaff and Cheſter.

MY LORDS,

The following Sheets are addreſſed to your Lordſhips in two Reſpects, not only as ſuggeſting the future Means of improving your own Eſtates, but alſo of making ſuch Improvements, the ſure Plan of communicating ſimilar Bleſſings to the Property of others. Theſe Advantages, the Northumberland and Lowther Eſtates may command ſo upon the Eaſt and Weſt Coaſt of England, in reſpect of Coal and Manufacture of Agricultural Salts, that the Profits of the Export of ſuch Salts, will enable your Lordſhips to ſupply your own Tenants at ¼ or ½ Prime Coſt. As far as reſpects Agriculture, it is your Lordſhips' Intereſt to co-operate with the landed Intereſt of Great-Britain and Ireland, in obtaining a Repeal of all Salt Duties and Reſtraints, that are inimical or hoſtile to her valuable Intereſts, under ſuch Proviſos as guard the Duties now levied upon common Salt.

"The Earl of Dundonald obſerves, my Lords, in his Treatiſe upon Agriculture, that Peat Moſſes and Fens have, hitherto, generally been conſidered as Nuiſances when in an unimproved State, or as Soils of the greateſt Fertility, when cultivated. Theſe different ſtates regard only the Peat Moſs or Fen itſelf, and have no Reference to any conſequences that might ariſe by the Application of Peat, or, of any Preparation of it to the neighbouring Lands. But as Peat has been diſcovered to be capable of being converted into the moſt valuable of all Manures, the Importance of the Peat Moſſes in Great Britain and Ireland, cannot, therefore, be too much impreſſed on the Minds of the Land Owners and Occupiers of theſe Countries."

"From Experiments made with Vitriolic, Phoſphoric, and Alkaline Salts, and Peat, it can be aſſerted, that the Effects of ſuch Mixture

ture, Weight for Weight, are equal, if not ſuperior, to thoſe of Dung. The uſual quantity of Dung given to an Acre of Ground, when it is intended to manure it effectually, is about Eighteen Tons: This it may, perhaps, receive once in five Years. It will require a Farm to be well managed, and in high Cultivation, to admit of one fifth of it to be annually ſo manured."

"The beſt cultivated Land, by return of its own Manure, unleſs when a quantity of Vegetable Matter has been accumulated, can do no more than keep itſelf in Heart, of courſe, nothing can be ſpared for the Amelioration or Improvement of poor or waſte Lands. The rendering the inert vegetable matter of Peat Moſſes and Fens ſerviceable to this purpoſe, though effected at a greater Expence than is at preſent incurred by any Application or dreſſing to Ground, could not fail to anſwer the expectation of the Farmer, and muſt be conſidered as a moſt valuable Improvement in the Annals of Huſbandry. Though Experience can only determine the Proportion of the above Salts to a certain Proportion of Peat, however, it may be calculated, that one Ton of particular Salts will make, with the Aid of Heat, 54 Tons of Peat into Manure."

"By Diſcoveries which have been made in preparing theſe Salts, they could be afforded at a cheap Rate, were the preſent high Duties on Sea Salt, and the Refuſe Liquor of Salt Works taken off, ſo far as may relate to theſe

Purpoſes. A Regulation of ſuch infinite conſequence to the Improvement and more complete Cultivation of the Lands in Great Britain and Ireland, is, of itſelf, a ſufficient Apology for calling a Meeting, my Lords, of the Freeholders of each County, to Petition Parliament for Relief in ſo important an Object."

To my Lord Biſhop of Landaff, the Work above mentioned is juſtly addreſſed, as many of your Lordſhip's Ideas, are quoted in the Sequel of it. The Author has to Apologize for his Deficiency, as to Chymical Knowledge. He hopes, however, he has done Juſtice to thoſe Authors he has quoted, by bringing forward their Merit in a practical way of being of Service to his Country and Mankind. He enjoys one Satisfaction, an aſſurance from them who have the Ability of performance, that the more uſeful Hints thrown out in this Tract, will have proper Attention paid to them.

To my Lord Biſhop of Cheſter, any Propoſitions, that tend to eſtabliſh the Manufacture of Agricultural Salts, at Northwich and Namptwich, may, with Propriety, be dedicated, by a Clergyman of your Dioceſs — Your Lordſhip's worthy Predeceſſor, had formerly expreſſed to me, by Letter, his willingneſs to promote any Improvement of ſuch uſeful Tendency. A Reviſion and Repeal of that part of the Britiſh Salt Laws, that are unfavourable to Agriculture, will have a two fold Effect of improving the Salt Manufacture of Cheſhire, and of increaſing the Reſources of forming Manures, in the moſt diſtant and inland Counties in the three Kingdoms.

Before I conclude this Paper, it may be proper, Gentlemen, to obſerve, that the Syſtem you propoſed to the Tenant of my Glebe, to feed his Horſes upon cut Clover and Graſs, during the Summer Months and Autumn, will enable him to make more Manure, to commix with the Clay Marl, than by this preſent plan of paſturing, where three parts out of four of the Dung is loſt in Evaporation, and in breeding Inſects and Flies. Upon this Plan a large Cow or Ox will make in one Year 60 or 70 Tons of Manure.

It is obſerved, Gentlemen, by the Writer mentioned above, that "were Manures excluſively applied, under a Syſtem of convertible Huſbandry, to Graſs Lands, the Lands would be broken up in due Rotation of Cropping, and there can be no doubt, but that a greater quantity of Corn and Herbage would be annually produced. Top dreſſing eſpecially to Meadow and Paſture Ground, is undoubtedly, the beſt Mode of applying Manure. The convertible Huſbandry, or the Management of Farms, in an alternate Courſe of Tillage and Paſture, is, in general, well underſtood in the highly cultivated parts of Scotland, from which Syſtem, the Crops of Artificial Graſſes are infinitely more abundant, than in the old Mode of Cultivation."

Solutions of Salts, previous to their Commixture with Animal and Vegetable Subſtances, or even before their Application to the Ground, ſhould be mixed with Clay Marl, if it can be obtained in the Neighbourhood.

In the County of Durham, Marl Pits may be opened at Winſton Hill, Blackwell Hill, Hurworth, Croft Bridge, Dinſdale, Yarm Bridge, Portrack, and Cowpen; and in Yorkſhire, at Piercebridge, Glebe Land of Manfield, Houghton Hill, in that Pariſh, Cleaſby, Croft, Eryholme, Yarm, and down to Stockton Bridge, and Mandell, upon Lord Harewood's Eſtate, where the Clay Marl is 20 Feet in thickneſs, and Level Free to the River Tees.

Darlington commands a fine Poſt of Clay Marl, cloſe to it, at the Brick Kiln Pits, upon the Road leading to Stockton. Trials of it, at a ſmall Expence, may be made both by the Neighbouring Farmers and Gardeners, in Compoſt with common Dung, or Town Manure.

Under this Marl there is a rich Calcareous Loam of ſix feet in thickneſs, which mixed with the Urine of Cattle, may be deemed the beſt Manure that can be applied to Garden Ground, or Land in Tillage,

With all reſpect, I remain,
GENTLEMEN,
Your moſt Obedient Servant,
JAMES ATHOL COCHRANE

Manfield, Auguſt 25, 1800.

BRITISH MUSEUM

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